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WASTE OIL DISPOSAL AT THE DEPARTMENT OF ENERGY

FACILITIES AT OAK RIDGE, TENNESSEE*

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Oak Ridge Gaseous Diffusion Plant

ABSTRACT

The disposal of waste oil generated at the USDOE facilities in Oak Ridge has become a significant problem in recent years. The presence of radioactivity and other contaminants in some oils prohibits the use of commercial disposal and oil reclamation firms, and, thus, often necessitates on-site disposal. Recent and proposed federal regualtions have and will continue to control all waste oil disposal operations, including those of the Department of Energy.

In order to ensure adequate and acceptable disposal of waste oils, a special committee of UCC-ND personnel located in Oak Ridge was established in December 1978 and asked to make appropriate recommendations for both near-term and long-range operations. Included in this paper is a brief description of the efforts of the committee, the associated efforts of development and engineering personnel, and conclusions and recommendations pertaining to UCC-ND waste oil disposal.

*Based on work performed at the Oak Ridge Gaseous Diffusion Plant operated by the Union Carbide Corporation, Nuclear Division, for the Department of Energy.

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FACILITIES AT OAK RIDGE, TENNESSEE

The disposal of waste oils and coolants is currently and will continue to comprise a significant portion of the overall waste disposal effort at the USDOE facilities in Oak Ridge. While a small quantity of the oils can be and are sold to commerical reclaimation firms, the majority cannot, primarily due to the presence of different contaminats, including radioactivity and PCB's. It is thus mandatory that acceptable means of disposal be provided by UCC-ND within the DOE reservation.

Current Generation, Storage, and Disposal Practices/Problems

The three Oak Ridge plants generate several different types of waste oils and coolants, but the majority can be classified as either water-soluble machine coolants, water-insoluble hydrocarbon oils, water-insoluble mineral oils, or water-insoluble synthetic oils. In general, the majority of the water-soluble coolants are generated by the large machine shops located at the Y-12 and K-25 sites. The primary generator of the hydrocarbon oils is the K-25 cascade lube oil system with smaller quantities being generated by routine vehicle maintenance at all the plants. The waste mineral oils and synthetic oils are generated at all the sites, primarly as a result of maintenance on electrical equipment, diffusion pumps, vacuum pumps, and hydraulic systems.

The water-soluble machine coolants generally do not contain detectable PCB's or enriched uranium and consist of about 95 percent water and only 5 percent oil. They are very ameneable to the biological degredation process currently employed at the Y-12 plant. Since this process produces an environmentally-acceptable effluent which should continue to comply with all proposed regulations, it is anticipated to be the primary means of disposal for the coolants for the next several years.

The method(s) of disposing of hydrocarbon, mineral and synthetic oils is dependent upon the concentration of contaminants. In general, the oils containing less than predetermined safe levels of all such contaminants are sold to commercial reclaimation firms.

The disposal of oils containing greater than the predetermined level of any one or a combination of contaminants is a much more complex process. For example, waste oils containing greater than 50 ppm of normal or depleted assay uranium, any level of enriched uranium (greater than 0.71% U-235), any detectable PCB's and/or greater than 1 ppm of beryllium are not sold and thus must be disposed of in some other manner. In the past, all such oils having criticality safety approval (i.e. nonfissile oils) were landfarmed at the Y-12 site. Due to the complications associated with landfarming oils containing even trace levels of PCB's the decision was made to discontinue all landfarming of oils containing any detectable PCB's as of July 2, 1979. As a result of this decision a significant quantity of oil has been and will continue to be accumulated in storage. The oils containing less than 50 ppm of PCB's and less than the predetermined levels of other contaminats may be disposed of in any manner that does not result in direct entry into the environment. Oils containing greater than 50 ppm but less than 500 ppm of PCB's may be shipped to a commercial PCB disposal facility or burned in EPA approved high-efficiency incinerators/steam boilers. The oils containing greater than 500 ppm of PCB's are required to be incinerated in EPA approved PCB incinerators. Since none of these oil/PCB disposal methods are currently acceptable for wastes containing enriched uranium, all PCB-containing oils are being stored until appropriate uranium data can be obtained. Depending on the content of the uranium and/or other contaminants, the appropriate method(s) of disposal/storage can be and are determined. The various options for disposing of the wastes are discussed in subsequent sections of this report.

Waste oils that do not contain detectable levels of PCB's but do contain greater than the prescribed level of any other contaminant are landfarmed at the Y-12 site. While this means of disposal is currently environmentally-acceptable and legal, it will probably be prohibited by the Tennessee RCRA regulations, when they become effective. It is thus anticipated that landfarming will provide a viable means of waste oil disposal only through 1980. After this time increased storage in anticipation of acceptable long-term disposal will be required.

Development and Engineering Studies

In order to provide a sound technical basis on which to make decisions regarding long-range disposal of waste oils, several development and engineering studies were initiated in early 1979. At the Y-12 plant a major effort was expended on the study of removal of PCB's from waste oil through evaporation/distillation, solvent extraction, and absorption techniques.

The distillation system consisted of a two-inch diameter glass column that contained eighteen inches of 1/4 inch raschig ring packing above and below the feed point, a two liter glass reboiler, a feed preheater, and a distillate collection-reflux system. The column was operated at 5 mm Hg absolute pressure in the condenser and 10 - 15 mm Hg absolute pressure in the reboiler. The oil used for the study had a boiling range of approximately 200°C - 550°C at 760 mm Hg pressure. The feed oil contained approximately 3000 ppm of PCB's and during distillation the PCB's concentrated in the distillate.

During operation of the column, the reflux ratio and the temperature of the reboiler were varied to determine PCB removal and the feed split (feed to distillate/feed to bottoms), with the most important result being the amount of PCB's remaining in the bottoms. A summary of the test results follows:

[1]Reboiler Temp. (°C)	Reflux Ratio	Distillate Temp. (°C)	Feed Split	PCB in Bottoms (ppm)
290	9.0	185	25/75	950
290	2.5	195	30/70	250
300	2.0	210	40/60	55*
310	2.5	215	45/55	35*
320	2.5	220	50/50	10*

Calculations are being made to define through-put rates for various column sizes and column lengths.

[1]Temperature at 10 - 15 mm Hg Absolute Pressure

Solvent extraction is also being investigated as a means of removing PCB's from contaminated oil. The criteria for a favorable solvent include an affinity for PCB's, immiscibility with the oil, and inability to form emulsions. Approximately thirty solvents have been tested to date with only furfural showing favorable characteristics. The study was conducted using oil contaminated with approximately 80 ppm PCB. The PCB's distributed equally between the furfural and the oil, and the oil was approximately 5% soluble in the furfural.

A third approach to removing PCB from oils is being investigated through the use of commercially available PCB absorbers. One such absorber consists of a filer unit containing a rubber compound for removal of PCB from transformer oils. Two units have been ordered for evaluation in the laboratory and in field tests.

A development study is being conducted at ORGDP to investigate removal of enriched uranium from waste oil to facilitate safe and environmentally-acceptable disposal. Laboratory analyses reveal that uranium concentrations in waste oil at ORGDP generally range from 400 ppm to 58,000 ppm.

Scoping studies have indicated that three filtration methods can reduce uranium concentrations. Absolute filter paper reduced uranium from 9,000 ppm to 150 ppm, but the effective flow rate was small. Cross-flow filtration through porous tubes reduced the uranium concentration from 31,000 ppm to 840 ppm while concentrating the residue to 81,000 ppm; however, tube pluggage occurred during operation. Pressure filtration was also investigated extensively and uranium removal to concentrations of less than 50 ppm were achieved on some samples. Laboratory tests were also conducted on several types of filter precoats to determine filtration rates. In one test run with precoat pressure filtration and a coarse cellulose filter aid, the concentration of uranium in the filtrate was found to decrease from 1400 ppm to 50 ppm. However, effective filtration did not occur until a layer of tar-like material had formed on the filter cake. These filtration studies are continuing.

In conjunction with the various development efforts, UCC-ND Engineering conducted a study of the feasibility of cleaning waste oils for recycle and/or reuse as fuel in oil-fired steam generating boilers. In general the study consisted of four options - two involving treatment and two involving ultimate disposition/reuse. The treatment (cleaning) processes evaluated were simple evaporation and distillation, and the dispositon alternatives included burning in a new package oil-fired boiler and burning in modified existing oil-fired boilers. Included as auxiliaries to both clean-up alternatives were a storage building, oil-water separators, filters, storage tanks, preheaters, and the required pumps and piping.

Based on preliminary results of the aforementianed development work, the engineering study concluded that the treatment processes would produce from 80,000 to 90,000 gallons of clean oil each year and a waste sludge that would amount to about 30% of the original volume of waste oil. This particular study did not include provisions for disposing of the waste material. The capital costs of the various treatment/reuse alternatives were estimated to be from $1.9 million to $2.2 million, as escalated to FY-1984-2. The annual operating cost of any one of the options was estimated to be about $160,000.

Long-term Disposal Alternatives

Given the results of the development and engineering studies, several alternatives means of waste oil disposal will be evaluated, primarly on the basis of technical feasibility, economics, and regulatory compliance. As mentioned previously, the existing method for disposing of non-PCB, water-soluble machine coolants by biological degradation in an old cooling tower basin is currently in compliance with all applicable regulations and is expected to remain in compliance with proposed RCRA regulations. It has thus been concluded that it should be continued to be utilized as the primary means of coolant disposal.

The disposal of water-insoluable oils presents a more complex problem, primarly due to the presence of various contaminants, that cannot be adequately solved with existing resources. While the current practice of storage of these oils certainly precludes any immediate unacceptable disposal, it is apparent that some means of disposal must ultimately be provided. As described in previous sections, it has been determined that after proper treatment, such as filtration and/or distillation, the majority of the waste oils could be reused or burned as fuel. Unfortunately, the cost of such a system would be high, (about $2 million) and the identified processes would produce sludges containing concentrated PCB's, uranium and other contaminants. The disposal of the sludges would then present a similar disposal problem, on a smaller scale, as did the PCB/oil materials.

Another long-term alternative that should provide for complete disposal of waste oil and produce only an inorganic residue with concentrated uranium would consist of a high-temperature incineration system. This system could be designed and constructed to handle both solids and liquids of varying viscosities, including PCB's, waste oils, and organic solvents such as kerosene. Such a system is currently included in the "Gaseous Diffusion Long-Range Plans" for FY-1983 at a budgeted cost of $25 million.

The feasibility of each of these options is being studied by UCC-ND engineering personnel and a decision regarding the optimum means of long-term disposal will be made in the near future.

Since any new disposal system will not be funtional for several years, each plant will be required to provide adequate interim storage. Such storage must be in compliance with all applicable regulations and, especially in the case of the PCB's, will require significant capital expenditures.

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